

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (currently amended): A valve operating apparatus for an internal combustion engine including:

- a housing [[(2)]];
- a reciprocating piston [[(1)]] residing wholly within the housing [[(2)]], the reciprocating piston [[(1)]] driving one or more poppet valves [[(7)]];
- a first fluid supply path [[(3)]] and a first fluid drain path [[(5)]], each path being controllable to supply or drain fluid to/from a first reciprocating piston end [[(16)]];
- a second fluid supply path [[(4)]] and a second fluid drain path [[(6)]], each path being controllable to supply or drain fluid to/from a second reciprocating piston end [[(17)]];

wherein said reciprocating piston [[(1)]], in use, is driven between a first position and a second position by controlling said fluid in said supply and drain paths [[(3, 4, 5, 6)]], thereby operating said one or more poppet valves [[(7)]], and wherein characterised in that a connector [[(9)]] passes through an aperture [[(14)]] in said housing [[(2)]] to connect said reciprocating piston [[(1)]] to said one or more poppet valves [[(7)]], said reciprocating piston [[(1)]] in co-operation with an internal wall of the housing forming a seal to prevent substantial egress of fluid through said aperture [[(14)]] from the first reciprocating piston end [[(16)]] and from the second reciprocating piston end [[(17)]].

2. (currently amended): A valve operating apparatus according to claim 1 wherein characterised in that said aperture [[(14)]] is substantially sealed by at least a portion of the external surface of said reciprocating piston [[(1)]] to prevent egress of fluid from the housing [[(2)]] through said aperture [[(14)]].

3. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that said aperture [[(14)]] is located in a side wall of said housing [[(2)]], and wherein an external side wall surface of said piston [[(1)]] in conjunction with an internal side wall surface of said housing forms said seal to prevent substantial egress of fluid from the housing [[(2)]] through said aperture [[(14)]].

4. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that the longitudinal axis of said connector [[(9)]] is substantially perpendicular to the longitudinal axis of said piston [[(1)]].
5. (currently amended): A valve operating apparatus according to claim 1 wherein the any one of the preceding claims characterised in that a connector rod [[(9)]] is a rod fixed to the reciprocating piston [[(1)]] and connects to said one or more poppet valves [[(7)]].
6. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that said first reciprocating piston end [[(16)]] and said second reciprocating piston end [[(17)]] have substantially the same surface area.
7. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that each of said first fluid supply path [[(3)]], first fluid drain path [[(5)]], second fluid supply path [[(4)]] and second fluid drain path [[(6)]] has an independently operable control valve [[(24)]], said control valve [[(24)]] operable to have a closed, partially open or open state, operation of the four said control valves [[(24)]] regulating the flow of fluid to said first and second reciprocating piston ends [[(16, 17)]], thus enabling control of the movement of the reciprocating piston [[(1)]] and hence operation of the one or more poppet valves [[(7)]].
8. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that a reservoir of high pressure fluid [[(22)]] is in fluid connection with one or more of said fluid supply paths [[(3, 4, 5, 6)]].
9. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that fluid in said supply and drain paths [[(3, 4, 5, 6)]] is controlled by an engine management system controller [[(19)]], said engine management system controller [[(19)]] controlling the operation of the reciprocating piston [[(1)]] and thus enabling variable lift and variable timing control of said one or more poppet valves [[(7)]].

10. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that said reciprocating piston [[(1)]] may be decelerated by controlling said fluid in said supply and drain paths [[(3, 4, 5, 6)]] to avoid crashing of said one or more poppet valves [[(7)]] onto their respective seats.

11. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that said reciprocating piston [[(1)]] is biased [[(12)]] when in an inoperative state to a predetermined position, thereby biasing each said poppet valve [[(7)]] to a predetermined position and the biasing means [[(12)]] being prevented from acting on the reciprocating piston [[(1)]] when said reciprocating piston [[(1)]] is in an operative state.

12. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]].

13. (currently amended): A valve operating apparatus according to claim 1 wherein any one of the preceding claims characterised in that said connector [[(9)]] connecting the reciprocating piston [[(1)]] to the one or more poppet valves [[(7)]] allows each poppet valve [[(7)]] to spin about its longitudinal axis.

14. (currently amended): An engine including a valve operating apparatus according to claim 1 any one of the preceding claims.

15. (currently amended): A motor vehicle including a valve operating apparatus according to claim 1 any one of the preceding claims.

16. (new): A valve operating apparatus according to claim 2 wherein:

- said aperture [[(14)]] is located in a side wall of said housing [[(2)]], and wherein an external side wall surface of said piston [[(1)]] in conjunction with an internal side

wall surface of said housing forms said seal to prevent substantial egress of fluid from the housing [[(2)]] through said aperture [[(14)]]; and

- said connector [[(9)]] is a rod fixed to the reciprocating piston [[(1)]] and connects to said one or more poppet valves [[(7)]]; and
- fluid in said supply and drain paths [[(3, 4, 5, 6)]] is controlled by an engine management system controller [[(19)]], said engine management system controller [[(19)]] controlling the operation of the reciprocating piston [[(1)]] and thus enabling variable lift and variable timing control of said one or more poppet valves [[(7)]].

17. (new): A valve operating apparatus according to claim 16 wherein said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]].

18. (new): A valve operating apparatus according to claim 16 wherein each of said first fluid supply path [[(3)]], first fluid drain path [[(5)]], second fluid supply path [[(4)]] and second fluid drain path [[(6)]] has an independently operable control valve [[(24)]], said control valve [[(24)]] operable to have a closed, partially open or open state, operation of the four said control valves [[(24)]] regulating the flow of fluid to said first and second reciprocating piston ends [[(16, 17)]], thus enabling control of the movement of the reciprocating piston [[(1)]] and hence operation of the one or more poppet valves [[(7)]].

19. (new): A valve operating apparatus according to claim 18 wherein said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]].

20. (new): A valve operating apparatus according to claim 16 wherein said first reciprocating piston end [[(16)]] and said second reciprocating piston end [[(17)]] have substantially the same surface area.

21. (new): A valve operating apparatus according to claim 20 wherein said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]].

22. (new): A valve operating apparatus according to claim 20 wherein each of said first fluid supply path [[(3)]], first fluid drain path [[(5)]], second fluid supply path [[(4)]]] and second fluid drain path [[(6)]]] has an independently operable control valve [[(24)]], said control valve [[(24)]]] operable to have a closed, partially open or open state, operation of the four said control valves [[(24)]]] regulating the flow of fluid to said first and second reciprocating piston ends [[(16, 17)]], thus enabling control of the movement of the reciprocating piston [[(1)]] and hence operation of the one or more poppet valves [[(7)]]].

23. (new): A valve operating apparatus according to claim 22 wherein said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]]].

24. (new): A valve operating apparatus according to claim 16 wherein said reciprocating piston [[(1)]] may be decelerated by controlling said fluid in said supply and drain paths [[(3, 4, 5, 6)]] to avoid crashing of said one or more poppet valves [[(7)]] onto their respective seats.

25. (new): A valve operating apparatus according to claim 24 wherein said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]]].

26. (new): A valve operating apparatus according to claim 24 wherein each of said first fluid supply path [[(3)]], first fluid drain path [[(5)]], second fluid supply path [[(4)]]] and second fluid drain path [[(6)]]] has an independently operable control valve [[(24)]], said control valve [[(24)]]] operable to have a closed, partially open or open state, operation of the four said control valves [[(24)]]] regulating the flow of fluid to said first and second reciprocating piston ends [[(16, 17)]], thus enabling control of the movement of the reciprocating piston [[(1)]] and hence operation of the one or more poppet valves [[(7)]]].

27. (new): A valve operating apparatus according to claim 26 wherein said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]]].

28. (new): A valve operating apparatus according to claim 24 wherein said first reciprocating piston end [[(16)]] and said second reciprocating piston end [[(17)]] have substantially the same surface area.

29. (new): A valve operating apparatus according to claim 28 wherein said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]].

30. (new): A valve operating apparatus according to claim 28 wherein each of said first fluid supply path [[(3)]], first fluid drain path [[(5)]], second fluid supply path [[(4)]] and second fluid drain path [[(6)]] has an independently operable control valve [[(24)]], said control valve [[(24)]] operable to have a closed, partially open or open state, operation of the four said control valves [[(24)]] regulating the flow of fluid to said first and second reciprocating piston ends [[(16, 17)]], thus enabling control of the movement of the reciprocating piston [[(1)]] and hence operation of the one or more poppet valves [[(7)]].

31. (new): A valve operating apparatus according to claim 30 wherein said reciprocating piston [[(1)]] is partially hollow, said hollow [[(18)]] providing a surface upon which vertical force may act at least at one end [[(16, 17)]] of said reciprocating piston [[(1)]].